Article 34

We claim:

1. A method of mapping a volumetric electrical potential distribution of a heart chamber (80) arising from electrical activation in a myocardium as measured from both an electrode array (19) within the endocardial cavity, said electrode array not in contact with the surface of said endocardial, and from a reference electrode (24) at the interior surface of said heart chamber (80) at a known distance from said electrode array (19), said reference electrode (24) in contact with the surface of said heart chamber, and said electrode array (19) together with reference electrode (24) defining a reference position comprising the steps of:

measuring the geometric shape of said heart chamber, and generating volume data from said geometric shape measurement;

computing the position of said electrode array (19) within said heart chamber, from said volume measurement, and from said reference position, and generating array position measurement data;

measuring electrical potentials on said array, and generating electrical potential measurement data;

computing the three-dimensional volumetric electrical field distribution of said heart chamber volume from a solution to LaPlace's equation containing said electrical potential measurements, and said array position measurement data;

displaying said volumetric electrical field distribution.

2. The method of claim 1 wherein said measuring the geometric shape of said heart chamber step comprises the substeps of:

generating a sequence of impedance

AMENDED SHEET

plethysmographic signals characterizing said heart volume; and

generating said volume measurement data from said signals characterizing said heart volume.

3. A mapping catheter of the type having a set of electrodes which may be deployed within a patient's heart, for use in mapping cardiac electrical potentials of a patient's heart comprising:

a set of electrodes (19);

first positioning means coupled to said set of electrodes for spacing a portion of said set of electrodes, defined as a first subset of electrodes, apart from and not in contact with a surface of said patient's heart (12);

second positioning means coupled to said set of electrodes for placing a second predetermined subset of said set of electrodes (24) into contact with a surface of said patient's heart;

third positioning means coupled to said set of electrodes for placing a third predetermined subset of said electrodes (26) into a position in a wall of said patient's heart.

4. The apparatus of claim 3 wherein said set of electrodes exceeds twelve electrodes.

5. The apparatus of claim 3 wherein said first subset of electrodes exceeds one.

6. The apparatus of claim 3 wherein said second subset is at least one.

7. The apparatus of claim 3 wherein said first positioning means is substantially spherical in shape.

8. The apparatus of claim 3 wherein said second positioning means has a substantially cylindrical shape.

~~9.~~ A catheter assembly (10) for mapping the interior of a patient's heart comprising:

a first set of electrode sites defining a first substantially spherical electrode array (19);

said electrode array (19) sized such that a substantial number of said electrodes are not in contact with the patient's heart;

a second set of electrode sites (24) displaced from said electrode array, located in contact with said patient's heart.

~~10.~~ A catheter assembly (10) for mapping the electrical potential of the interior of a heart chamber of a patient's heart comprising:

a flexible lead body (72), connected to a deformable lead body (74), said flexible lead body and said deformable lead body having a lumen;

said deformable lead body deformable to a first collapsed position wherein said deformable lead body has a substantially cylindrical shape and, said deformable lead body deformable to a second expanded position wherein said deformable lead body has a substantially spherical shape;

an electrode array (19) having a plurality of electrode sites located on said deformable lead body, wherein said electrode sites form a spherical array of electrode sites when said deformable lead body is in said second expanded position;

a reference catheter (16) having a tip electrode assembly;

said reference catheter (16) being located in said lumen and supported for relative motion with respect to said electrode array such that said tip electrode assembly may be placed into contact with said

patient's heart when said array is in said heart chamber.

11. The catheter assembly (10) of claim 10 further comprising:

means for excluding blood (77) from the interior of said deformable lead body when said deformable lead body is in said second expanded position.

~~12.~~ A method of forming a catheter comprising the steps of:

a) forming a collection of insulated wires each having an interior conductor, and each having an exterior insulation coating;

b) braiding the wires formed in step a) forming braided structure having a central lumen;

c) incorporating the braided structure in a polymeric material forming a flexible lead body;

d) removing said polymeric material from a portion of said flexible lead body exposing said braid of insulated wires forming a deformable lead body;

e) removing insulation from selected locations on selected insulated wires to form electrode sites on said deformable lead body.

14. The catheter assembly of claim 1 further comprising:

means for excluding blood from the interior of said deformable lead body when said deformable lead body is in said second expanded position.

15. The catheter assembly of claim 8 wherein said flexible lead body comprises a braid of insulated wires incorporated into a polymeric sheath.

16. A method of forming a catheter comprising the steps of:

a) forming a collection of insulated wires each having an interior conductor, and each having an exterior insulation coating;

b) braiding the wires formed in step a) forming braided structure having a central lumen;

c) incorporating the braided structure in a polymeric material forming a flexible lead body;

d) removing said polymeric material from a portion of said flexible lead body exposing said braid of insulated wires forming a deformable lead body;

f) removing insulation from selected locations on selected insulated wires to form electrode sites on said deformable lead body.